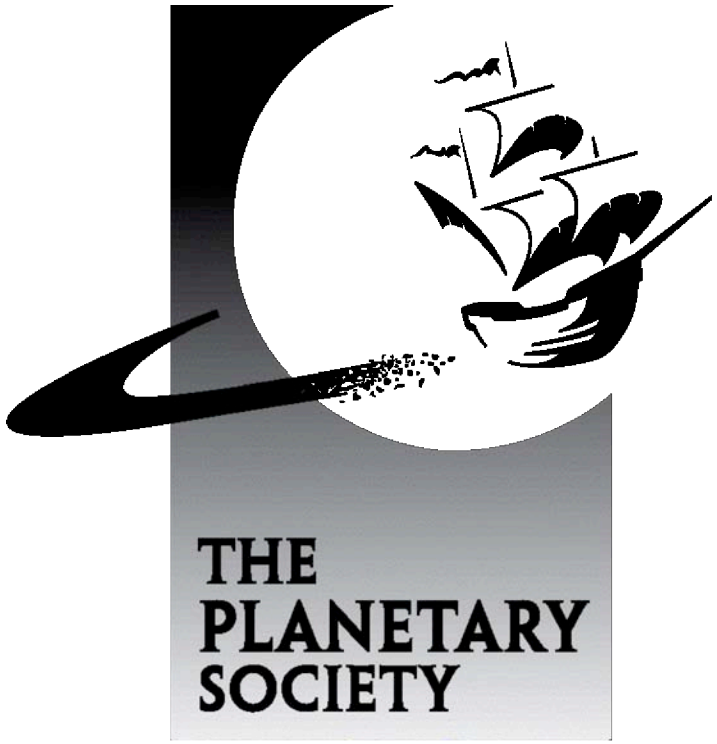

AIM FOR MARS!

Presentation to the NASA
Mars Roadmap Committee

8 Feb 2005

Background

- The Planetary Society – NGO, no government funding, advocacy for Moon to Mars exploration policy http://planetary.org
- TPS/AAS/ASE Human Transportation Workshop in April 2003 laid groundwork with conclusions about cargo-crew separation and international cooperation http://www.planetary.org/workshop/
- Public involvement for Aim For Mars! includes member support of studies and ideas for exploration

  http://planetary.org/aimformars/learnmore.html

Extending Human Presence into the Solar System

Concepts for First Manned Mission to Mars - A Russian Perspective

International Lunar Way-Station

AIM FOR MARS!

Extending Human Presence Into The Solar System

An Independent Study For The Planetary Society-
http://planetary.org/aimformars/initiatives.html

Study Team

- William Claybaugh
- Owen K. Garriott (co-Team Leader)
- John Garvey
- Michael Griffin (co-Team Leader)
- Thomas D. Jones
- Charles Kohlhase
- Bruce McCandless II
- William O'Neil
- Paul A. Penzo

Stage 1, 2005-2010

*Retire Orbiter ASAP, by 2010 or before--

But after access to LEO is assured ,

and International commitments are met

*Accelerate simple (Block 1) CEV, before the end of 2010, eliminating manned ("crewed") hiatus to LEO

*Use ISS for Exploration objectives (long duration exposure for crews, teamwork demo, LS experiments, hardware & systems. etc.)

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*Consider single stage SRB (plus second stage) for CEV launch (see Av. Week, June 28,2004)

Stage 2, 2011-2015

- Upgrade CEV for interplanetary cruise
- Develop Lab, Hab, Consumable, Propulsion modules for interplanetary ops
- Develop HLV, possibly shuttle derived
- Enable:
  - Orbital missions to lunar poles, back side, surveys, site selection, remote sensing, etc.
  - To Lagrange points (astronomy, etc.)
  - To asteroids (techniques to adjust their orbits)
  - To Mar's moons, Phobos and Deimos, remote sensing and preliminary sample selection
  - Destination selection not required now

*Conduct LEO and interplanetary ops

Stage 3, 2015 and beyond

- Develop landers for Lunar and Mars surfaces
- Conduct continuing interplanetary and surface ops
- Costs spread over ~15 to 20 years, to eliminate peaks (see Av. Week, Oct.4,2004)
- Studies needed to validate vehicle launchers recommended

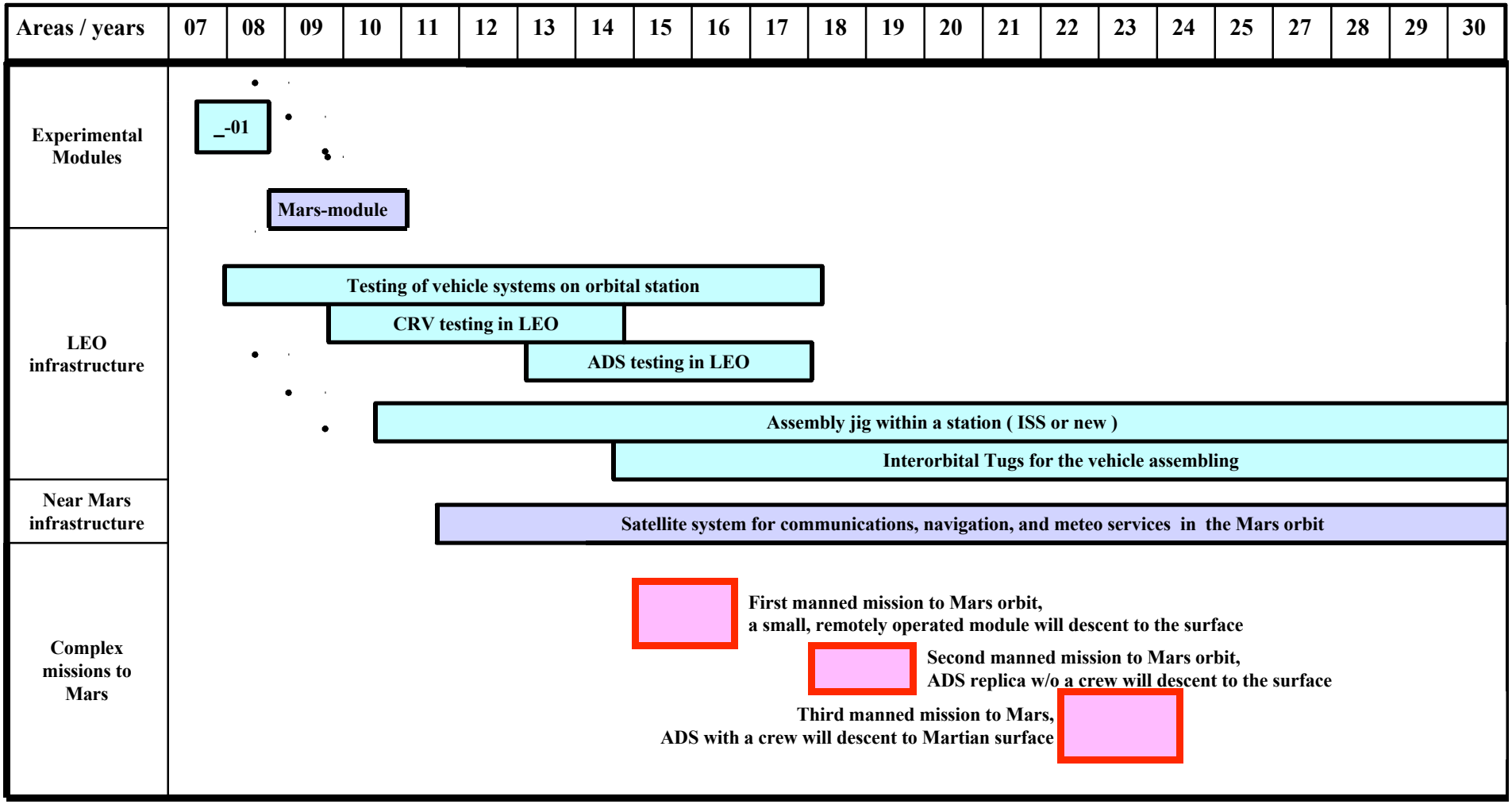
Russian Study: Selection of Concepts for first Manned Missions to Mars

From ISTC Study by Energia, Keldysh, IKI and other Organizations

- **Conclusion: Currently, it is not advisable to link the activities on the Martian Mission activities to the new LV development for this purpose. Just perfect LV for the Interplanetary Complex delivery would be LV with a 35 – 40 t payload. Such a launch vehicle could be designed to meet different tasks. Assuming the launch vehicle is not developed the modifications of the existing launch vehicles, such as Proton or Ariance-5 could deliver the Interplanetary Complex elements.**
- **Conclusion: the experience gained from missions on orbital stations gives an evidence for the multiple reuse of the interplanetary vehicle, provided the modular and functional redundancy is sufficiently increased and turnaround preventive replacements of hardware parts are done**
- **Conclusion: Before man landing, vehicles with unmanned Ascent & Descent System shall be flown to Mars**
- **Conclusion: to use bases on the Martian surface for the first missions is deemed unreasonable**
- **Conclusion. Testing of the Martian vehicle elements in the lunar environment will not bear any additional results against the similar tests in the Earth environment but, on the contrary, it sufficiently increases the program cost. Testing of ADS elements in the real Martian environment is a compulsory test phase.**

РКК ЭНЕРГИЯ им. С.П. КОРОЛЕВА

Program of First Martian Missions



Missions in LEO

Unmanned missions to Mars

Manned missions

РКК ЭНЕРГИЯ им. С.П. КОРОЛЕВА

Purpose of in-flight validation of technical solutions on Martian mission

Year	Object	Tasks
2007	Module _1 (Module delivered to station by Progress)	Testing of solar array assembling technology with the ISS crew involved. Testing of electric propulsion, film SA, investigation of electric propulsion in-flight interaction in a cluster. Implementation of the program for near-satellite atmosphere research and investigation of impact from the electric propulsion main engines to the module equipment and space-ground communications
	ISS	Testing of closed loop ECLSS
2009	ISS	Testing of SA module elements and modified systems
2009	ISS	Testing of short-radius centrifuge effect to a crew in a long-duration flight.
	Mars-module	Testing of solar tug module assembling technology with the use of the jig, robotics, and involving the ISS crew. Testing of electric propulsion, investigation of electric propulsion interaction in a cluster. Testing of electric propulsion, investigation of electric propulsion interaction in a cluster. Testing of working medium storage and supply system, solar tug electric drives. Mars exploration program implementation including the unmanned module descent to the surface.
2010	CRV model	Testing of atmosphere braking dynamics.
2011	ADS model	Testing of atmosphere braking dynamics
2014	IMC mission 1	Mission without the crew landing to the surface ADS Model testing
2018	IMC mission 2	Mission without crew landing to the surface ADS testing in real Martian environment
2021	IMC mission 3	Mission with the crew landing to the surface

ISS

Modules

ADS and CRV Models

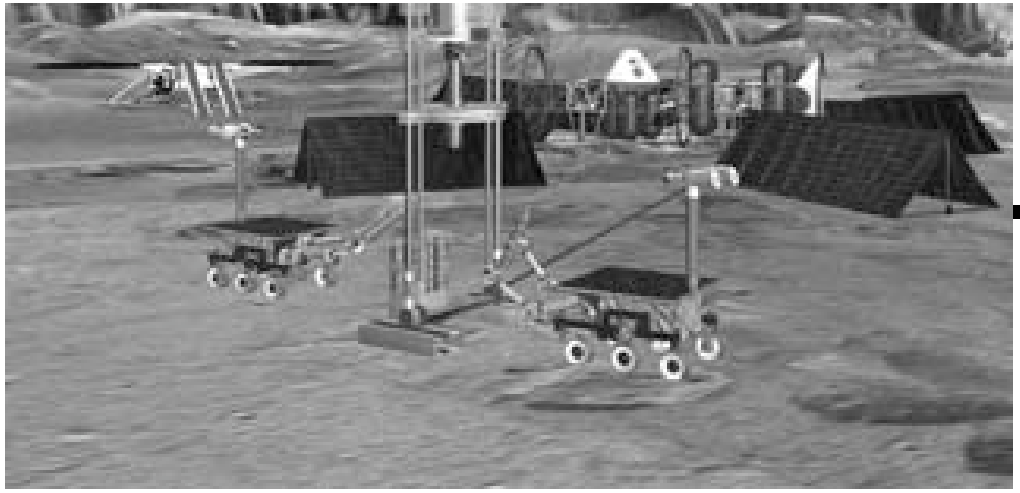
IMC

International

- Political support – Rationale and vision are inherently global
  - Nationalistic rationale is weak
- Technical support – Other nations have value added
  - Russian human program and infrastructure
  - ESA planetary program is significant and admirable
  - Japan, China and India on the way to the Moon
- Economic support – Required commitments are large,
- Space race is likely – cooperation more productive that competition
- Need to build broad public support

International Lunar Way Station: A Planetary Outpost Test Bed

A Recommendation from The Planetary Society



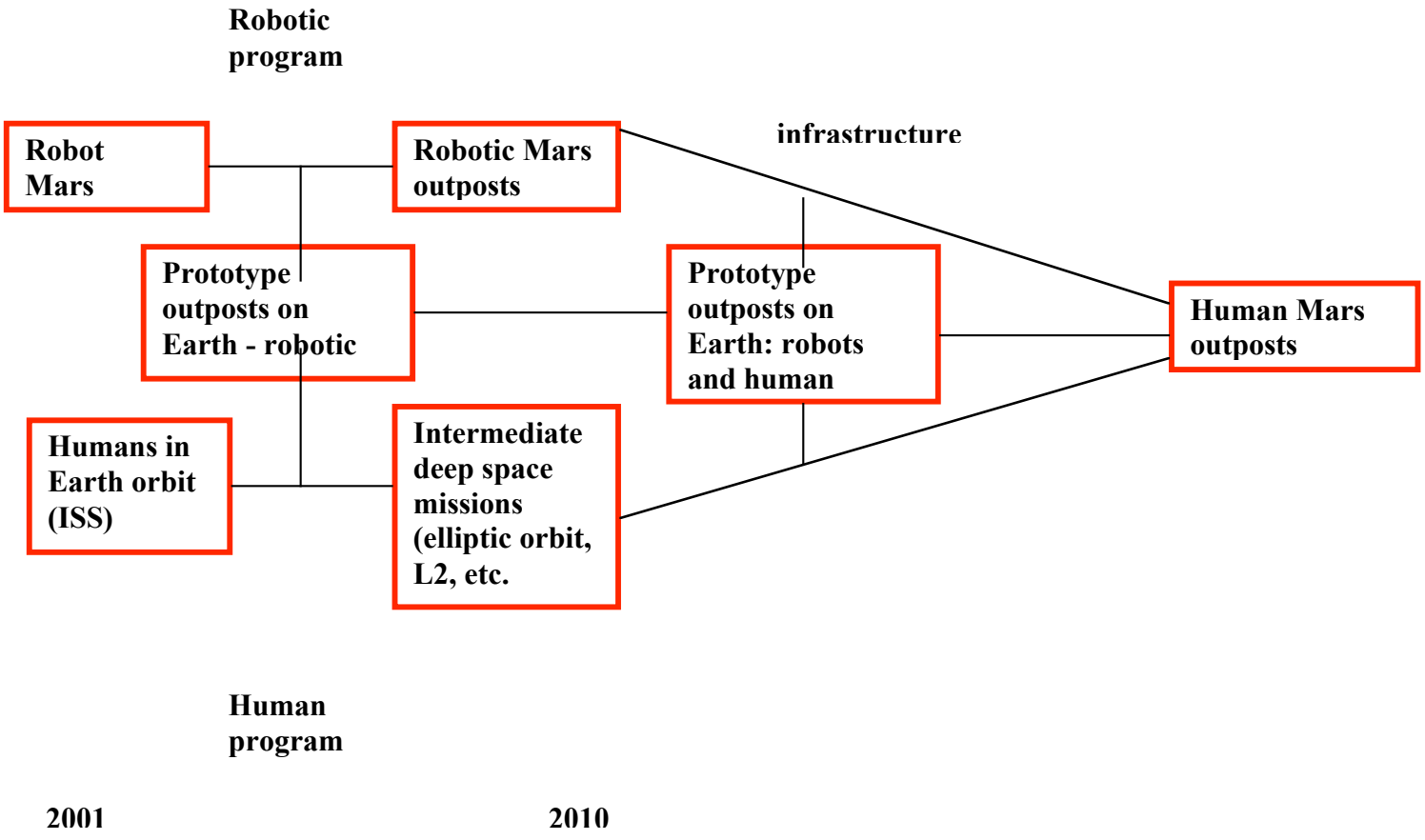
Systematically building up sustained robotic, then human assets at selected sites on a given planetary body.

International Lunar Way-Station

- Test Mars elements:
  - Robotic reconnaissance, orbital and *in situ.*
  - Emplacement of autonomous and nearly autonomous robotic assets
    - *e.g.,* beacons, communication assets
  - Practicing surface rendezvous and surface operations
  - Interactions between robotic elements.
  - Use of Mars-like communication satellites and data links
  - Human surface ops, including science exploration.
  - Robotic and human asset interaction
- Simultaneously do valuable lunar science
- Effective public engagement – e.g. public driving rovers

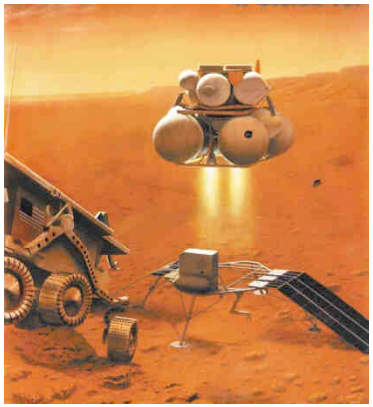
This should be part of the Mars roadmap

Mars Outpost Program



What is a Mars Outpost?

- Place where humans will begin to become a multi-planet species
- An infrastructure for the first human mission
- A scientifically interesting site suitable for investigating the questions of life
- A goal for a series of robotic missions and for permanent robotic presence



Attributes: The Mars Outpost

- Publicly exciting, visionary, engaging, tangible, evolving, educational and motivational
- Goal for the robotic program
- Goal for the human program
- Flexible as to timing and resources
- Science and technology driven and driving

"A broad international vision encompassing the full spectrum of international players"

International Planning Needed

- Lunar near-term for both technical and political reasons
  - Coordinate Europe, Japan, China, India, US orbiters
  - Establish ***mutual relay capability*****,** on the orbiters to enable creating a ***more accurate lunar gravity model***
  - Coordinate orbits, to maximize the use of this mutual relay capability for gravity measurements
- Mars roles and responsibilities TBD
  - MSL international plan
  - Phobos/Grunt mission
  - MSR international plan
  - Integration of human mission preparations
    - Space station
    - Crew Exploration Vehicle mission
- Engage public in planning & developing the Mars Outpost
- New Inter-Agency Coordination Group(s)?